Simpósio sobre

PLANTIO DIRETO E MEIO AMBIENTE

Sequestro de Carbono e Qualidade da Água

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IMPACT OF THE KYOTO PROTOCOL RATIFICATION ON GLOBAL TRANSACTIONS OF CARBON
IMPACTO DA RATIFICAÇÃO DO PROTOCOLO DE KYOTO NAS TRANSAÇÕES GLOBAIS DE CARBONO

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Resumo
O aquecimento global é um golpe na saúde do planeta. O consumo de combustíveis fósseis nos tempos modernos para acionar os motores, aquecer as casas, e produzir os inúmeros produtos manufaturados têm provocado o aumento dos gases de efeito estufa (GEE). Some of these gases occur naturally, others are man-made. Alguns desses gases ocorrem naturalmente e outros são produzidos pela ação antropogênica (pelo homem). O dióxiodo de Carbono (CO_2), o óxido nitroso (N_2O) e o metano (CH_4) são os três GEE liberados de forma significativa de fontes agrícolas. Conforme esses gases acumulam-se na atmosfera terrestre, eles bloqueam as ondas de calor contribuindo para o efeito estufa e que muitos acreditam que irá resultar em climas mais quentes com impactos na variabilidade do clima original.

O protocolo de Kyoto é um acordo internacional estabelecendo metas para os países industrializados reduzirem a emissão dos GEE. O protocolo de Kyoto, é uma revisão para a *United Nations Framework Convention on Climate Change (UNFCCC)*, caracterizando-se como uma aliança internacional para reduzir o aquecimento global. Isso também reafirma uma sessão do UNFCCC. Os países que ratificaram o protocolo se comprometeram em reduzir a suas emissões de CO2 e de outros cinco GEE ou envolver-se no comércio das emissões se eles mantém ou aumentaram a emissão desses gases que estão ligados ao aquecimento global. Esses gases são considerados no mínimo parcialmente responsáveis pelo aquecimento global - O aumento na temperatura global tem conseqüências catastróficas para a vida do planeta. O protocolo negociado em na cidade de Kyoto no Japão em dezembro de 1997, foi assinado em 16 de março de 1998 e concluído em 15 de março de 1999. O acordo teve sua maior força em 16 de fevereiro de 2004, seguido de sua ratificação oficial pela Rússia em 18 de novembro de 2004.

O aumento no nível dos GEE na atmosfera foi um requisito pata que todas as nações estabelecerem um acordo internacional com metas definidas visando políticas que possibilitem a redução dos GEE. Vários cientistas que estudam o clima têm dito que as metas estabelecidas pelo protocolo de Kyoto estão meramente atingindo a borda do problema. O acordo visa reduzir as emissões das nações industrializadas em somente 5% enquanto que os cientistas afirmam que seria necessário reduzir em até 60% das emissões para evitar conseqüências piores na variação do clima. Enquanto nós aprendemos sobre o armazenamento de C no solo e seus benefícios sobre o meio ambiente, nós necessitamos entender os benefícios extras da agricultura conservacionista como o plantio direto, e o significado de uma produção agrícola sustentável. Compreendendo esses benefícios ao meio ambiente e adotando práticas conservacionistas no uso do solo, poderemos aumentar a harmonia entre o homem e a natureza enquanto conseguimos produzir alimentos e fibras. O protocolo de Kyoto para o UNFCCC estabelece uma responsabilidade com as mudanças climáticas. A implementação completa do protocolo requer mudanças nas ações políticas que resultem em maior aceitação e proporcione maior incentivo financeiro para seqüestrar C e associar isto aos benefícios já descritos. Embora o dreno na agricultura possa ser temporário, é importante saber que na maioria das situações de dreno terão valores positivos, embora não seja tão grande como aos associados às reduções permanentes. O nosso entendimento atual do papel da biosfera no balanço global de C pode não estar adequado para dar suporte a decisões políticas satisfatórias. Os resultados atuais e o potencial do seqüestro de C podem ainda ser desconhecidos e difíceis de determinar. Aumentando o estoque de C no solo pode aumentar a infiltração e a fertilidade, reduzir a erosão hídrica e eólica, minimizar a compactação, melhorar a qualidade da água, reduzir a emissão de C, reduzir o movimento de pesticidas e melhora a qualidade do meio ambiente. A inclusão de drenos no protocolo de Kyoto é o principal passo para

imaginar um sistema de contabilidade aceitável para a terra, mas, nós necessitaremos continuamente melhorar nosso entendimento da biosfera terrestre e os drenos no solo se quisermos que o protocolo de Kyoto realmente funcione. Sem o protocolo, os governos, políticos e as companhias privadas que trabalham no sistema amistoso e informal sobre a economia do clima não terão grandes desafios. O aceite do desafio de manter produção segura dos alimentos adição do C armazenado no solo em sistemas conservacionistas demonstra a nossa preocupação com os recursos globais e nossa visão em trabalhar em harmonia com a natureza.

Key Words: no-till, CO_2 emissions, environmental benefits, soil carbon, soil organic matter, carbon credits

Introduction

Global warming is a threat to the health of the planet according to many scientists. The consumption of fossil fuels over modern times to power engines, heat homes, manufacture consumer goods and more has resulted in a buildup of greenhouse gases (GHG). Some of these gases occur naturally, others are man-made. Carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) are three significant GHG released from agricultural sources. As these gases accumulate in the earth's atmosphere, they trap heat, thus contributing to the greenhouse effect that many believe will result in a warmer climate with a shift in weather patterns towards more variability. High levels of fossil fuel combustion and deforestation have transformed large pools of fossil C from coal and oil into atmospheric CO_2. Conservation and increased fuel efficiency are important players in reducing CO_2 emissions from the use of fossil fuels. One proposed method to reduce atmospheric CO_2 buildup is to increase the global storage of C in soils. Additional benefits to this solution are the potential for simultaneous enhancement in agricultural production and ecosystem services for enhanced environmental quality. Conservation agriculture can play a major role in enhancing soil C and environmental quality in our production systems. International strategies aimed at reducing CO_2 in the atmosphere include soil C sequestration, forestry, and ocean sequestration of C. Other technological strategies to reduce C inputs include developing energy efficient fuels, and efforts to develop and implement non-C energy sources, such as hydrogen fuel cells. All of these efforts combined can reduce CO_2 concentrations in the atmosphere and help to alleviate global warming. International concerns about potential global warming resulted in the Kyoto Protocol in 1997.

What is the Kyoto Protocol?

The Kyoto Protocol is an international agreement setting targets for industrialized countries to cut their GHG. The Kyoto Protocol is an amendment to the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty on global warming. It also reaffirms sections of the UNFCCC. Countries which ratify this protocol commit to reduce their emissions of CO_2 and five other GHGs or engage in emissions trading if they maintain or increase emissions of these gases, which have been linked to global warming. These gases are considered at least partly responsible for global warming - the rise in global temperature which may have catastrophic consequences for life on earth. The formal name of the proposed agreement, which reaffirms sections of the UNFCCC, is the Kyoto Protocol to the United Nations Framework Convention on Climate Change. (http://www.cnn.com/SPECIALS/1997/global.warming/stories/treaty/). The protocol was negotiated in Kyoto, Japan in December 1997, opened for signature on March 16, 1998, and closed on March 15, 1999. The agreement will come into force on February 16, 2005 following its official ratification by Russia on November 18, 2004.

The detailed requirements for a C accounting system are still being developed by the Intergovernmental Panel on Climate Change (IPCC) under the UNFCCC. The IPCC is in the process of developing *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. This document is intended to be submitted for the 9th Conference of the Parties (COP9) to the UNFCCC. Any C accounting standard developed prior to the release of this document will need to be varied to be consistent with the IPCC document before C credits generated from C sinks can be used in an emissions trading regime under the Kyoto Protocol. The concept of carbon credits within the Kyoto protocol can be addressed several ways; Clean Development Mechanism (CDM) is project between Annex I and Annex II countries, Joint Implementation (JI) with projects between Annex I countries, Emissions Trading (ET) that allows transfer of assigned amount of units internationally and domestic carbon credit training. The two types of carbon credits and markets allow Emission Reduction Units (ERU) that are more permanent in nature and traded like a commodity. The Emission Removal Units (RMU) are not permanent and treated as a lease. The protocol sets a commitment period of 2008 to 2012. The 30 industrialized countries that signed up to reduce their emissions must prove they have done so as an average over the five years. The Kyoto Protocol aimed to reduce global emissions of GHG for those 30 countries by 5.2 % below 1990 levels (Grubb et al. 1999).

Soil Carbon Sinks

Atmospheric concentrations of CO_2 can be lowered either by reducing emissions or by taking CO_2 out of the atmosphere and storing it in terrestrial, oceanic, or freshwater aquatic ecosystems. While the burning of fossil fuels in combustion engines, or the production of electricity from coal-fired generators are 'sources' of CO_2, removal of C from the atmosphere and storage in tree biomass or as organic matter in soils, are "sinks". A sink is defined as a process or an activity that removes a GHG from the atmosphere. This removal process is achieved naturally, and quite effectively, through photosynthesis. Living plants take CO_2 from the air and in the presence of sunlight and water, convert it into seeds, leaves, stems and roots. Oxygen is released through the process. Part of the CO_2 is retained and "sequestered", or stored, as C in the soil sink. The long-term conversion of grassland and forestland to cropland (and grazing lands) has resulted in historic losses of soil C worldwide, but there is a major potential for increasing soil C through restoration of degraded soils and widespread adoption of soil conservation practices. Many researchers believe that agriculture has the potential of becoming a much larger sink for CO_2, if specific management practices are followed.

A C sink is a reservoir that can absorb or "sequester" CO_2 from the atmosphere and include forests, soils, peat, permafrost, ocean water and carbonate deposits in the deep ocean. Most of these C sinks are very large and very slow moving; human influence on these sinks is generally deemed fairly minimal, with the possible exception of soils and agriculture. Oil, coal and natural gas represent the final evolution of pre-historic C sinks that are now "fossilized" into mineral form. The most commonly referenced form of C sink is that of forests. Plants and trees absorb CO_2 from the atmosphere via photosynthesis, retain the C component as the building block of plant fiber and release oxygen back into the atmosphere. Therefore, long-lived, high biomass plants, such as trees and forests represent effective C sinks as long as they are maintained. The degree to which the positive impacts of "sinks," both forestry and soils, can be captured and utilized in an emissions trading context is still a matter of contentious debate at the IPCC and other forums.

In addition to being a generator of GHGs, agriculture has the potential to sequester (or store) large amounts of C and other GHGs in the soil (Lal et al. 1998; IPCC, 2000). The activities that may enhance the storage of C in agricultural soils include planting trees, converting from conventional to conservation tillage, adopting improved cropping systems, converting to perennial crops and restoring wetlands among other practices. Clearly, conservation agriculture and residue management improvement have the most potential to sequester C in agricultural soils. The prospect of sequestering C in agricultural soils has generated substantial interest both in the scientific community and among policymakers in the US. Lal et al. (1998) estimate the physical potential of US cropland to sequester C at between 75 million and 208 million metric tons of C per year. This physical potential cannot be realized, however; without policies that take into consideration farmers profit motives. Policies under discussion include formal C markets and direct incentive payments or subsidies to farmers through a government program.

Soil Sinks are Complex

The Kyoto Protocol on climate change proposes that countries should be allowed to soak up some of their emissions of greenhouse gases using biological "sinks." The nature of biological or biospheric sinks is dramatically different from other more permanent items in the C balance. Major emissions from fossil fuels and cement production show a slow steady increase. Biospheric uptake depends on the weather, the amount of precipitation, temperature and radiation, and displays a variability associated with the main weather patterns. The rate of photosynthesis and thus C sequestration is influenced by such factors as climate, soil characteristics, topography, species and age of the biomass. Accumulation of sequestered C in soils and forests tends to be slow in the early stages of growth, but accelerates as crops and trees grow towards maturity and then decreases once maturity is reached. Superimposed on this, are pulse events like forest fires, major storms and insect plagues that are continually changing the C balance of the biosphere. This leads to considerable variation in the terrestrial uptake and subsequent conversion to soil sinks on the scale of a few years to a decade. This temporal variation contributes to uncertainty and limited acceptance of soil C credits. The uncertainty associated with forestry sinks as carried over to soil C sinks. We will need to better understand and control the natural C cycle if we are to keep CO_2 from flooding the atmosphere and wrecking our climate. And soils, like forests, are destined to play a key role (Lal, 2002).

There are many unanswered questions about the use of soil and forest C sinks to meet GHG emissions target has raised doubt about their utility in the contribution of agriculture. The scientific community is working hard to provide reliable methods of measuring, monitoring and verifying C contents in soils. Agricultural sinks are acknowledged in the Kyoto Protocol (particularly in Article 3.4) in a limited manner. International consensus has not been reached on the role of C sequestration in soils for the first reporting period under the Kyoto agreement. International activities that can help achieve consensus include workshops focusing on sequestration activities and an IPCC report currently underway on land use, land use change and forestry and the potential for GHG offsets. Keys to gaining international understanding of C sequestration include developing scientifically sound projections of the potential for sequestration from agricultural activities and developing internationally agreed-upon methods for determining, reporting and verifying changes in soil C stocks.

Under the Kyoto protocol, C sequestration through reforestation is explicitly allowed, though no role currently exists for agricultural soils. The language of the protocol clearly allows for future admission of agricultural soils sinks; however, member countries are not likely to ratify its inclusion until key implementation issues are resolved. The inclusion of sinks in the Kyoto protocol is a major step forward in realizing comprehensive C accounting system for the earth, but we continually need to improve our understanding of the terrestrial biosphere if we are to make a Kyoto protocol really work.

The primary objectives of C sequestration are usually not related solely to climate change issues, but rather to such aims as reducing environmental pollution and natural resource degradation. Agricultural soil management can play an important role. Intensive tillage in modern farming practices disrupt the C cycle (Reicosky and Lindstrom, 1993; Reicosky, 2001). Soils which contain about 75 % of C found on land are excellent sinks. However, once cultivated, the amount of organic matter that soils contain drops by 20-50 per cent. The amount of CO_2 can also be influenced by human management, forest fires, drought or a particularly favourable growing season. Farmers have shown successfully that agricultural soils can be managed to store more CO_2 from the atmosphere when farmers adopt practices that increase yields and reduce soil disturbance due to tillage. Adopting these practices results in more of the CO_2 that the crop plants absorbed from the atmosphere while they were growing being converted in the soil to organic C, where it is stored and does not return to the atmosphere. Support and encouragement of the best management practices to reduce soil degradation and environmental pollution would be entirely consistent with mitigation measures for reduction of greenhouse gas emissions.

The Concept of Carbon Accounting

In order for the C sequestered in vegetation to be used as part of an emissions trading regime, it is essential that correct and defensible accounting be undertaken of the amount of C that is captured in biomass. The mechanism for calculating C sequestered in biomass is referred to C accounting. It is also necessary that correct accounting treatment is applied to situations in which that C is no longer sequestered in biomass, such as through fire, disease or destruction of the biomass. The C accounting mechanism must be sufficiently robust that the C trading market has confidence that the amount of C sequestered can be considered to be equivalent in its impact on global warming potential to the C released to the atmosphere from activities producing greenhouse gases. Confidence in the C accounting system is fundamental to building confidence in use of C sequestration in a C trading market, thereby underpinning growth and investment in new planted forests to create new C credits from sequestration.

Changes in soil C stocks are difficult to verify because of their temporal and spatial heterogeneity. The most direct means of determining soil C sequestration is to measure, over time, sequential changes in soil C. Such measurements are complicated by the slow rate of change. Soil C can exhibit significant field-scale variability due to varying topographic and management history. Ongoing studies to quantify the capacity for agricultural activities as C sinks are needed. Many researchers agree that we need to strengthen the soil C database, obtain better data on soil processes that affect C and increase our knowledge about the C effects of land conversion and soil management. There is a need to develop and standardize a methodology that will translate farm and forest systems in a landscape to C sequestration rates. Agriculture is expected to do its part, but farm leaders must be prudent, review the best available science, and be involved in the policy decision making process. Despite these concerns, there is ample reason to be optimistic that effective market mechanisms or government programs, can be devised to include agricultural soils in an effective GHG mitigation policy.

Carbon sequestration perspectives, policies and Developing Global Markets

The increase in GHG concentrations in the atmosphere is a global problem that requires a global solution (Kimble et al., 2002; Lal, 2002). Concern about negative effects of climate warming resulting from increased levels of GHG in the atmosphere has led nations to establish goals and policies for reductions of these emissions. Initial targets for reductions are stated in the Kyoto protocol to the United Nations framework convention on climate change, which allows trading credits that represent verified emission reductions and removal of greenhouse gases from the atmospheres (United Nations Framework Convention on Climate Change Secretariat, 1997). The emissions trading may make it possible to achieve reductions in net greenhouse gas emissions for far less cost than without trading (Dudek et al., 1997). Storing C in soils using conservation agriculture techniques can help offset greenhouse gas emissions while providing numerous environmental benefits such as increasing site productivity, increasing water infiltration, and maintaining soil flora and fauna diversity (Lal et al., 1998; Lal, 2002). Storing C in forests may also provide environmental benefits resulting from increased numbers of mature trees contributing to C sequestration (Row et al., 1996).

As interest in soil C sequestration grows and C trading markets are developed, it is important that appropriate policies be developed that will prevent the exploitation of soil organic C and at the same time replace the lost C and establish its value (Walsh, 2002). Policies are needed that will encourage the sequestration of C for all environmental benefits that will evolve (Kimble et al., 2002). Making C a commodity necessitates determining its market value and doing so with rational criteria. Both farmers and society will benefit from sequestering C. Enhanced soil quality benefits farmers, but farmers and society in general benefit from erosion control, reduced siltation of reservoirs and waterways, improved air and water quality, and biodegradation of pollutants and chemicals. Farmers need to be compensated for the societal benefits of C sequestration and the mechanisms that develop will allow for C trading and maintaining property rights. One important criterion in developing the system is the measurement and verification of the C options for sequestration that must be developed and the importance of making policymakers aware of these procedures and the technical difficulties. The use of the C credit market mechanisms is intended to help meet the challenge of climate change and future C constraints that enable sustainable development and at the lowest social cost. Carbon credit accounting systems must be transparent, consistent, comparable, complete, accurate, and verifiable (IPCC, 2000). Other attributes for a successful system include global participation and market liquidity, linking of different trading schemes, low transaction costs, and rewards for early actions to voluntarily reduce emissions before regulatory mandates are put in place. Characterizing the relationships between soil C and water quality, air quality and all the other environmental benefits should be an easy sell to get social acceptance. The largest impediment is the educational processes directed at the policymakers and food consuming public that require further enhancement.

A growing number of organizations around the world are implementing voluntary projects that are climate-beneficial as a means to improve efficiency and reduce operating costs and risk. Businesses and institutions throughout the world are realizing that the benefits of good environmental management far outweigh the cost, both now and in the future, of good corporate management that include strategies to reduce GHG emissions, risk exposure, costs and enhance overall competitive operations. Multinational organizations are participating in C energy credit trading markets in order to avoid future compliance costs and to protect their global franchise in the face of increasing concern over global warming (Walsh, 2002). In the evolution toward a global economy and as concerns over global environmental impacts increase, CO_2 emissions management will become a factor in the planning and operations of industrial and government entities all over the world, creating challenges and opportunities for those who are able to recognize and capitalize on them.

Trade in C credits has potential to make conservation agriculture more profitable and enhance the environment at the same time. The potential for C credits has attracted considerable attention of farmers and likely buyers of the C credits. However, it is difficult to stay fully informed about developing C credits because of their technical complexity and the pace of development on this subject. Rules for trading in C credits are not yet agreed upon, but international dialogue is underway to develop a workable system and rules for trading. The number of organizations working on developing a C trading system in appendix table 1 suggests that some type of international mechanism will evolve and that soil C credit trading will become a reality. Information is rapidly becoming available on publicly traded C credits; however, little information is available on privately traded contracts. A great deal of uncertainty exists at this time as to what companies will emerge as reliable sources of high-quality information and has entities that can handle trading in a fair and reliable manner. Potential suppliers and buyers of C credits are urged to proceed with caution because many of the issues central to C credit markets and trade are yet to be clarified. We must convince policy makers, environmentalists and industrialists that soil C sequestration is an additional important benefit of adopting improved and recommended conservation agricultural production systems. This option stands on its own, regardless of the threat of global climate change from fossil fuels.

Conservation agricultural practices can help mitigate global warming by reducing C emissions from agricultural land and by sequestering C in the soil through regulatory, market incentive, and voluntary or educational means (Lal, 2002). Public policy can encourage adoption of these practices. For the present, there is a degree of uncertainty for investors and potential investors in forest related C sinks over the specific rules that will apply to implementation of the sinks provisions of the Kyoto Protocol. Investors and potential investors in C sinks need to be aware that there is uncertainty at the international level. Administration and transaction costs could play a key role in determining the success of any C credit trading system. Cost of these areas are expected to be minimized through improved techniques and services for measuring and reporting sequestered C, private sector consultants, economies of scale, and the emergence of market mechanisms and strategies such as C pooling or aggregating. There are risks involved in selling C credits in advance of any formalized international trading system and those participating in early trading need to clarify responsibilities and obligations. However, care should be taken in the design of these policies to ensure their success and to avoid unintended adverse economic and environmental consequences and to provide maximum social benefit.

Summary

Increased levels of GHGs in the atmosphere require all nations to establish international and national goals and policies for GHG reductions. Most climate scientists say that the targets set in the Kyoto Protocol are merely scratching the surface of the problem. The agreement aims to reduce emissions from industrialized nations only by around 5%, whereas the consensus among many climate scientists is that in order to avoid the worst consequences of global warming, emissions cuts in the order of 60% across the board are needed. While we learn more about soil C storage and its central role in environmental benefits, we must understand the secondary environmental benefits of conservation agriculture (no-till) and what they mean to sustainable production agriculture. Understanding these environmental benefits and getting the conservation practices implemented on the land will hasten the development of harmony between man and nature while increasing production of food and fiber. The Kyoto Protocol to the UNFCCC strengthens the international response to climate change. Complete implementation of the Kyoto protocol may require policy changes to increase the acceptance of and provide financial incentives for C sequestration and the associated benefits. Although agricultural sinks may be temporary, it is important to note that in most common situations the sinks will have positive value, albeit not as great as those associated with permanent reductions or abatement. Our current understanding of the role of the biosphere in the global C balance, however, may not be adequate to support policy decisions satisfactorily. The potential and actual C sequestration results may still be unknown and difficult to determine. Increasing soil C storage can increase infiltration, increase fertility, decrease wind and water erosion, minimize compaction, enhance water quality, decrease C emissions, impede pesticide movement and enhance environmental quality. The inclusion of sinks in the Kyoto protocol is a major step forward in realizing comprehensive C accounting system for the earth, but we continually need to improve our understanding of the terrestrial biosphere and soil sinks if we are to make a Kyoto protocol really work. Without Kyoto, the public, farmers, politicians and companies working towards climate-friendly economies would face even greater challenges. Accepting the challenges of maintaining food security by incorporating C storage in conservation planning demonstrates concern for our global resources and our willingness to work in harmony with nature. This concern presents a positive role for conservation agriculture through improved soil C management that will have a major impact on global sustainability and our future quality of life.

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Partial listing of carbon credit trading information programs and web site addresses as of 1 May 2003.

Australian National University Forestry
    http://www.farmwide.com.au/features/report12.pdf
Nebraska Carbon Sequestration Advisory Committee
    http://www.carbon.unl.edu/carbstor.htm
Chicago Climate Exchange.
    www.chicagoclimatex.com/html/ETIndia102502.htm
    http://www.chicagoclimatex.com/
Econergy International Corporation
    http://www.eic-co.com/Whois.htm
The Australian Greenhouse Office
    http://www.greenhouse.gov.au/emissionstrading/factsheets/qanda.html
Effluent Trading: Tradable Pollution Permits for Improved Environmental Quality
    http://ageco.tamu.edu/faculty/woodward/ET.htm
International Emissions Trading Association (IETA).
    http://www.ieta.org/
Cantor Fitzgerald's Environmental Brokerage Services
    http://www.co2e.com/common/faq.asp?intPageElementID=34307&intCategoryID=29
Environmental Financial Products, LLC.
    http://www.envifi.com/
The Carbon Trader
    http://www.thecarbontrader.com/
Point Carbon Price Forecasting
    http://www.pointcarbon.com/
Natsource - Consultative Services
    http://www.natsource.com/
The Prototype Carbon Fund
    http://www.prototypecarbonfund.org/router.cfm?Page=Home
Trexler and Associates, Inc. climate services
    http://www.climateservices.com/
Climate Change Knowledge Network News
    http://www.cckn.net/climate_news.asp
International Carbon Bank and Exchange
    http://www.carbonexchange.com
The Carbon Credit Portal
    http://www.carboncredit.org
World Bank Research
    http://www.worldbank.org/research/projects/global.htm
eCarbontrade
    http://www.ecarbontrade.com
The Carbon Protocol
    http://www.thecarbonprotocol.com
The Carbon Fund
    http://www.thecarbonfund.org
Clean Air Market Programs: Allowance Data
    http://www.epa.gov/airmarkets/trading
Agriculture's Role Discussed in Carbon Trading
    http://www.fb.com:80/news/fbn/html/agriculture_s.html